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Autor(en): **Bonetti, E. / Camprai, E.G.**

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STRUCTURAL INSTABILITY AND TRANSFORMATIONS IN AMORPHOUS METALS STUDIED BY MECHANICAL SPECTROSCOPY

E. BONETTI AND E.G. CAMPARI, Dipartimento di Fisica Università di Bologna
GNSM-CISM Via Irnerio,46 I-40126 ITALY

Abstract : Stress relaxation and Internal Friction tecniques applied to the study of structural ordering phenomena in metallic glasses, are useful to obtain information on the specific reversible and irreversible processes occurring after thermal ageing or straining.

1. Introduction

In metallic glasses the metastability characteristic of the as-cast alloys coupled to thermal e/o mechanical stimuli may induce strong modifications at a microstructural level. These are connected to atomic rearrangements in the amorphous state that induce transformations of different nature. Some of them are essentially reversible, whereas other ones alter irreversibly the local order of the alloys. These transformations can be modelled with reference to the behaviour of structural defects and, in particular, local shear type defects and local density fluctuations /1/. Some insight into the role played by the defects in determining structural stability and about the modifications in the amorphous state, can be provided by mechanically probing the specimens with static or dynamic stresses in different stress ranges. Some examples are illustrated below.

2. Stress Relaxation (SR)

Reversible ordering processes: the relaxation spectrum.

Measurements of the anelastic SR show that the localised shear transformations (LST) are widely distributed as regards relaxation times (fig.1). The reproducibility of the SR in subsequent runs ensures that in this regime the LST are reversible. This leads to a strong dependence of the measured relaxation curves on the loading rates (fig. 1 a-d). In principle this dependence makes it possible to evaluate the activation energy spectrum for SR (fig. 2)/2/.

Irreversible transformations.

In higher stress regimes, shear transformations are no longer uncorrelated. Moreover, local positive or negative density fluctuations may play a role, and irreversible effects are experienced. In SR measurements, for example, these are revealed by differences between the first and the successive stress relaxation runs (fig. 3). In some cases a negative stress relaxation was also observed /3/.

3. Internal Friction (IF)

The isocronal IF spectra on amorphous alloys which have undergone irreversible transformations in SR show that these are linked to the healing of different amounts of defects responsible for anelasticity (two-level sistems).

4. References

(1) T. Egami and D. Srolovitz J. Phys. F:Met. Phys. 12 2141
(2) E. Bonetti, E.G. Campari and N. Costa (to be published)
(3) E. Bonetti, E.G. Campari, L. Ferrari anr G. Russo J. Phys. F:Met. Phys. 18 (1988) 1351-1357

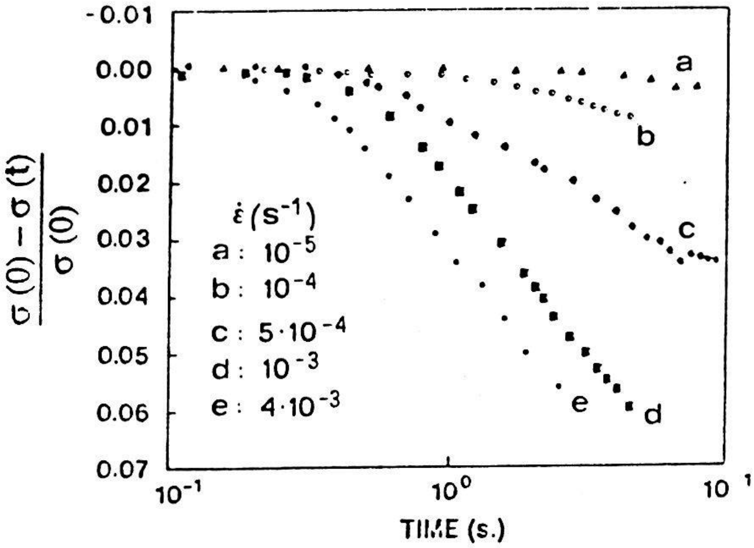

Fig. 1
Anelastic SR for $Fe_{67}Co_{18}B_{14}Si_{1}$ specimens loaded at room temperature up to 700 MPa at different strain rates.

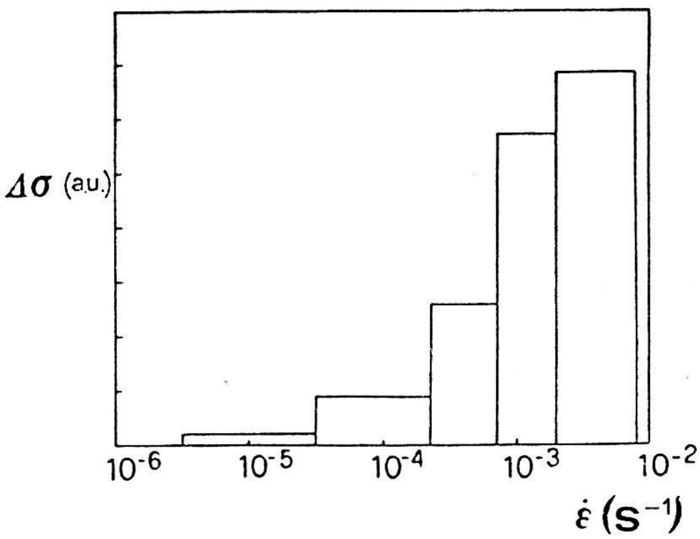

Fig. 2
Amount of SR after 4 s relaxation vs. strain rate.
In the limit of long times and $\Delta\dot{\varepsilon} \longrightarrow 0$, the histogram will reproduce the LST distribution.

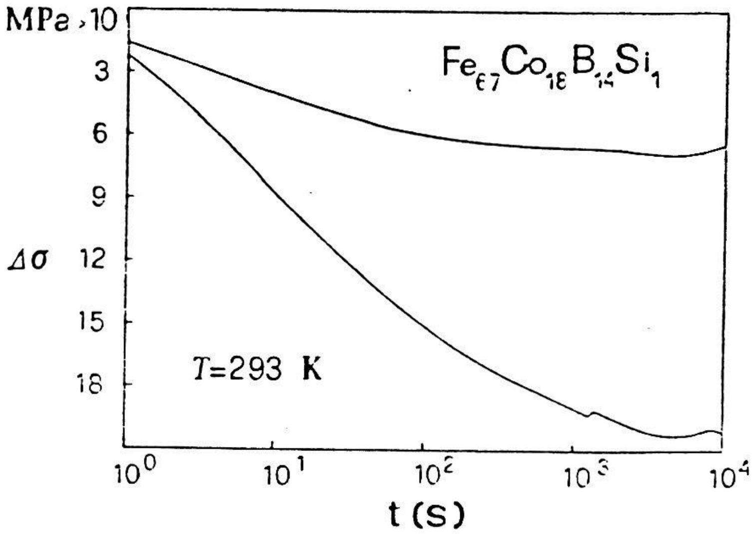

Fig. 3
Irreversible stress relaxation effect in two successive run. The stress at the beginning of SR was about 1.4 GPa .